APPENDIX-IV-A

Format for Outline (Synopsis) of Proposed Research Work

(To be supplied in four copies)

(Reference Ord. 124.11)

1. Name of Scholar (In English) : Jyoti Singh

   (In Hindi) : ज्योति सिंह

2. Title of the Research Work (In English): Floristic analysis of Mandal Tehsil, District Bhilwara with special reference to Eco-physiological study of family Lamiaceae.

   (In Hindi) : माण्डल तहसील, जिला भीलवाड़ा का वानस्पतिक विश्लेषण कुल लैमिएसी की पारिस्थितिकीय कार्यिकी के विशेष सन्दर्भ में।

3. Location

   a. Institution/Department where the work is to be done : Department of Botany, M.L.V. Government College, Bhilwara

   b. Geographical area of Investigation if any : Mandal Tehsil, District Bhilwara, Rajasthan

4. INTRODUCTION

Rajasthan is located in the north western part of India. It is the largest state sprawled in 3, 42, 239 sq. km area and comprises of 10.45% of the country's total area. Rajasthan exhibits great diversities, ranging from one of the oldest mountain ranges in the world, the Aravallies and the windblown sands of, the Thar Desert. Diverse topographic features can be seen in this state, though the bulk area is dry and arid. It has unique natural regions where distribution of plant species is actually limited. It is known to have unique floral biodiversity in Asia. It has wide range of habitats, climatic factors, physiography, soil types and geological antiquity. Phytogeographically, the state forms the eastern extremity of the great arid and semi arid belt of the world. The great Sahara desert belt passes through the western part of the state. The major part of the eastern and south-eastern region forms the

western part of the gangetic plains, the southern region forms a part of Malwa plateau and south-eastern region a part of Deccan plateau.

GENERAL CHARACTERISTICS OF THE DISTRICT

Bhilwara is one of the 33 districts of Rajasthan. It was formed as a separate district in 1949 on merger of the princely states of Mewar and Shahpura thikana in the erstwhile United Rajasthan. The district is full of remains of Stone Age civilization. Bhilwara is the industrial town famous for its textile industry hence called '*The Textile City'*.

STUDY AREA

The Bhilwara district lies in the south eastern part of Rajasthan. It extends from 25° 1'- 25° 58' N latitude 74° 1'- 75° 28' E longitudes. It has an average elevation of 421 meters (1381 feet).

The district is bounded in the north by Ajmer district, in the northwest, west and south west by Udaipur and Rajsamand district in the south and southeast while Chittorgarh district in the east and north east by Bundi and Tonk district. The total length of the district from west to east is 144 km .While the breadth from north to south is 104 km approximately. The total geographical area of the district is 10, 47, 441 hectares and covers approximately 3.05% of the state. There are seven subdivisions in the district and under these subdivisions there are 15 tehsils. The study area of the proposed work is Mandal tehsil. Its geographical coordinates are 25° 26' 21. 25" N latitude and 74° 35' 3. 86" E longitude.

Mandal is the biggest tehsil of Bhilwara district. It is surrounded by Banera and Bhilwara tehsil in the east, Asind in the north, Gangapur and Raipur in the west and Suwana in the south.

TOPOGRAPHY

Tehsil headquarter Mandal is 14 km towards north from district headquarters Bhilwara. Major attractions of this place are Mandal Pond (largest pond in Rajasthan) and Meja dam (major source of water supply) on the river Kothari. Mandal served as the military base of the Mughals when they had attacked Chittorgarh. The ruins of their campsite can still be seen today. A watch tower that was built on a small mound in Mandal is now a Devi temple.

The tehsil consists of an elevated plateau. The eastern part of the tehsil is a cluster of hills. The tehsil is intersected by the Aravali ranges at several places. The soil varies from

sandy loams to heavy loams. The tehsil Mandal has hot dry summer and cold winter with monsoon season from last week of June to mid-September and from mid-September to about the end of November is the post monsoon season.The rivers that meander their way through the Mandal tehsil are Kothari and Mansi. Mandal tehsil occupies an important role in the mineral map of Rajasthan. The main minerals are lead, zinc, soapstone, china clay, feldspar, quartz, mica, asbestos and garnet.

IMPORTANCE OF PROPOSED INVESTIGATION

The publication of the Flora of the Indian Desert by Bhandari, (1978), "Flora of North-East Rajasthan" by Sharma and Tiagi, (1979), "Flora of Rajasthan" by Shetty and Singh, (1987, 1991, 1993), "The Flora of Rajasthan" by Sharma, (2002) and an illustrated flora of Keoladeo National Park, Bharatpur, Rajasthan has been work out by Prasad *et al.* (1996). The Biodiversity of Desert National Park, Rajasthan was worked out by Singh and Singh (2006), which includes almost unexplored plants and animals, due to its inaccessible approach and being on the western border line. Biodiversity of Ranthambhore National Park has been investigated by Singh and Srivastava (2007). The "Flora of Rajasthan specially the South and South-East Region", by Tiagi and Aery, (2007) have added to our knowledge of the flora and floral composition of Rajasthan. Yadav and Meena (2011) dealt with the flora of South Central Rajasthan, which accounts for 686 naturalised vascular plant species belonging to 416 genera and 117 families.

The publication of the "Flora of Banswara", by Singh, (1983) and "Flora of Tonk District", by Shetty and Pandey, (1983) have further added to our knowledge of the flora and floral composition of Eastern Rajasthan.

The Indian desert, due to its geographical position, environment, topography and socio-economic conditions, first drew the attention of King (1869, 1870) who recorded the wild plants which were used as famine food and vegetable products as food in desertic zones of the state. Subsequently, Irwin (1895) furnished some ethnobotanical information for Ajmer, followed by Pank (1900). From 1960 onwards, a number of workers have contributed to the Ethnobotany. Joshi (1995) worked on Ethnobotany of the primitive tribes in Rajasthan after this there was a large gap related to systematical studies of Rajasthan. Recently, Meena (2011) has contributed to the ethnobotanical account of Rajasthan state.

The flora of Mandal tehsil has received a scantier attention of botanical workers. No work has been done on the flora of Mandal tehsil, district Bhilwara. In this respect, this tehsil requires an urgent need to document the floral composition for future data.

OBJECTIVES

To study the complete plant wealth of Mandal tehsil of district Bhilwara with special reference to family Lamiaceae, attempts will be made to explore different plant species in the tehsil. In this series flora of Mandal tehsil has now been proposed to be investigated under the following lines:

1. Botanical survey of Mandal tehsil in different seasons, collection of herbarium specimens and identification.
2. To study the topography and phytogeography, climate and soil factors of Mandal tehsil for evaluation of the overall nature of environment and its effect on plant growth.
3. Providing means of identification to the floral components from family Lamiaceae to intra specific level through keys, diagnostic description, illustrations and photographs.
4. To investigate the ecological aspects such as habitat wise classification and distribution patterns of plant communities, effect of biotic and climatic stress conditions on flora of Mandal tehsil.
5. Determination of depleting plant species and their categorization as per IUCN standards.
6. To study the systematic and micro morphological features such as epidermal features, stomata and trichomes of some selected taxa of family Lamiaceae for the taxonomic purposes.
7. To study the ecophysiological aspects such as photosynthetic pigments, membrane stability, foliar mineral content, sugars, amino acids, proteins and phenols of the selected taxa of the family Lamiaceae and to evaluate the adaptive strategies under the prevalent harsher climatic conditions of the area.
8. Determination of Ethnobotanical value in the tehsil area.

REVIEW OF THE WORK ALREADY DONE ON THE SUBJECT

(Present and past status)

The real predecessor in the work on the flora and present day Botany has been Linnaeus with his classic publication *Genera Plantarum* (1737). The study of the botanical riches of India owes much to the work of Roxburgh (1820-1824) who published "Flora Indica". Later eminent botanists like Hooker and Thompson (1855) published an 'Introductory Essay' to the flora of India with the publication of "Flora of British India" (1872-1897). The use of plants as a source of medicines has been an integral part of life in

India from the earliest times. Nature provides a bountiful pharmacopoeia through its plant life.

Ethnobotany has been defined by Ford (1978) as the study of direct interaction between humans and plants. The term "Ethnobotany" was first coined by Harshburger (1896). He applied the term to the study of plants used by primitive and aboriginal people. Plotkin (1995) defined ethnobotany as the study of tribal people and their utilization of tropical plants. Ethnobotany is an inter-disciplinary science drawing from different aspects of anthropology, archaeology, linguistic, history, botany, ecology, economics, medicine and several other disciplines. Duthie (1883) also made an exploratory tour of Rajputana forests. Adams (1899) listed about 50 species of plants in his book "The Western Rajputana States." In 1890, Macadam published a list of plants from Mt. Abu. Blatter and Hallberg (1918-1921) in a series of publications provided an enumeration of "The Flora of the Indian Desert" (Jodhpur and Jaisalmer), which for about 30 years remained the only authentic systematic account of the plants of Rajasthan. Parker (1918) recorded a number of plants from Jaipur. Duthie (1903-1929) in his monumental publication "Flora of Upper Gangetic Plains" included the major part of South-Eastern Rajasthan. Ramchandra Rao (1941) and Sankhala (1951) published lists of some plants of the desert region.

Detailed ecological studies on the vegetation of Rajasthan desert have also been undertaken by a number of workers (Krishnaswamy and Gupta, 1952; Barucha, 1960; Verma 1964; Sharma, 1967-68). Air photograph analysis of plant communities in the desert zone of Rajasthan was undertaken by Gupta and Abichandani (1968). The influence of climate on dry zone vegetation has been studied by Waheed Khan (1959), Raheja (1965), Meher – Homji (1970). Sen (1962, 1990), Puri and Jain (1962), Bhimaya *et al*. (1962), Mulay and Joshi (1964), Verma (1967), Bora (1973), have added to our knowledge on suitable species for afforestation in arid and semi-arid regions of Rajasthan.

Jain and Kotwal (1960) reported a few species which were not previously recorded from Rajasthan. Bhandari (1954, 1961a, 1963, 1964a) in a series of papers reported more than 50 species of plants for the first time from this area and also provided some critical notes on the identity and nomenclature of quite a few of these. Rolla and Kanodia (1962-1963) have listed some common plants of the area supported by herbarium specimens from particular localities and added notes on their flowering and fruiting seasons. Bhandari and Singh (1964) recorded *Dactyliandra welwistchii*, a monotypic genus, hitherto reported only from Angola and South-West Africa, for the first time from Indian desert. Santapau (1959)

designated the lectotypes of some of the new species and varieties of Indian desert plants described by Blatter and Hallberg (1918-21). All the above mentioned publications deal with the Western Rajasthan desert. Quite a large number of papers have been prepared on the floristic studies from the Eastern Rajasthan and desert also. Notable amongst those are of, Mulay and Ratnam (1950), Ratnam and Joshi (1952), Bakshi (1954), Nair (1956), Nair and Nathawat (1956, 1957), Nair and Kanodia (1959), Nair (1961), Nair and Malhotra (1961), Nair and Thomas (1962), and Nair and Koshy (1963).

The flora of Rajasthan has been attended by several workers. Bhandari (1978) and Sharma and Tiagi (1979) have worked out the flora of Western and North Eastern part of Rajasthan respectively. Shetty and Singh (1987, 1991, 1993) edited the flora of Rajasthan.
Recently, Tiagi and Aery (2007) published the flora of Rajasthan (South and South-East region). At the district level, flora of Banswara is prepared by Singh (1983) and flora of Tonk district is presented by Shetty and Pandey (1983).
Account of medicinal plants from tribal area of Rajasthan has been provided by Jain (1981), Joshi (1995a, 1995b). Sebastian and Bhandari (1984a, 84b, 1988), Vyas (1987), Sharma (1991), Singh and Pandey (1998), Katewa and Arora (1997), Katewa and Guria (1997), Katewa and Sharma (1998), Sharma and Asawa (1999). Deora *et al.* (2002), Rathore (2002), Trivedi (2002), Jain *et al.* (2004, 2005), Katewa and Galav (2005a, 2005b), Katewa and Jain (2006), Sharma (2002) presented the flora of Rajasthan which covers mainly the Eastern part of the state.

Yadav and Meena (2008, 2009), Meena and Yadav (2008, 2010, 2010a, 2010b, 2010c), Yadav *et al*.(2011, 2012) and Meena *et al.* (2011), Meena (2012, 2014, 2015) have added to our knowledge about the flora and floristics of the state.

LAMIACEAE

Family Lamiaceae Martinone (Labiatae Adans. Nom.alt.) have for centuries been acknowledged as a group of considerable pharmaceuticals and culinary interest. They are at the heart of industries ranging from kitchen herbs to essential oil extraction providing additives for tooth-pastes, medicinal and ointments. The vast acreage is devoted to the cultivation of certain genera in North America, Southern Europe and South-East Asia, including India. Lawrence (1951) reported 200 genera and about 3200 species of Lamiaceae. El. Gazzar and Watson (1970b) have identified two groups of plants in the Lamiaceae viz. (i) essential oil rich group and (ii) essential oil poor group.

In India, the family Lamiaceae has been represented by 425 species belonging to 69 genera (Mukherjee, 1940) which are about 13 percent of the total number of species found in the world. In Rajasthan, family Lamiaceae is represented by 41 species (Shetty and Singh, 1987- 93). Mukherjee (1940) before the middle of 20th century published a taxonomical monograph of the family Lamiaceae of the Indian empire based on Bentham's (1830, 1832-1836, 1848, 1876) concepts. Therein, he has dealt with 43 species and 11 intra-specific taxa belonging to the genus *Leucas* R. Br. Out of these 54 taxa, six species and two intraspecific taxa are considered endemic to Burma.

The data concerning the histological studies has been studied by several workers. Inamdar and Bhatt (1972) have studied the structure of development of stomata in some species of *Leucas* R. Br. Abu- Asab and Cantino (1987) have thrown considerable light on the types of stomata in *Leucas*. The consideration of correlations between morphological and chemical groping of taxa is as old as 1699 when J. Petiver established such correlation between medicinal (chemical) properties and certain morphological characters in Lamiaceae, Umbelliferae etc. The family Lamiaceae is well known for its medicinal and chemical properties, especially for terpenoids which may be used as taxonomic markers. The information about the useful aspects of family Lamiaceae for variation in purposes is widely scattered in the Literature. The notable contributions are those of Singh and Pandey (1998) and Kumar (2005) which deals with useful aspects of this family.

Beside above a number of scientific papers published in various Journals and taxonomical floras also provided valuable information dealing with this family. Members of Lamiaceae constitute an important component of terrestrial vegetation.

The presence of chlorophyll contents in angiosperms have been studied by Choy-Sin and Sun (1947) and Ludlow and Wolf (1975). Cell membrane stability has been studied by Yadav and Bhardwaja (1994) that throws light on Pteridophytes of Rajasthan. Charan and Sharma (2009, 2012) have worked on the effects of pesticides on the plants. All the above studies suggest that no work has been done on the family Lamiaceae of Rajasthan and there is a long gap for a detailed study of this family.

Thus, the perusal of literature has revealed that a lot of work has been done on the different aspects of the vegetation of Rajasthan as a whole but least work on flora at the tehsil level has been published so far. Therefore, in the present investigation flora of Tehsil Mandal has been taken up. Family Lamiaceae, one of the 10 dominant families of the study area has

been taken up for detailed investigations with special reference to its systematics, morphology, ecophysiology and phytochemistry

A thorough survey of literature indicates that no comprehensive study has been done on the floristic composition of this tehsil as well as on family lamiaceae.

RESEARCH GAPS IDENTIFIED IN THE PROPOSED FIELD OF INVESTIGATION
(Based on the review)

The publication of the Flora of the Indian Desert by Bhandari, (1978), "Flora of North-East Rajasthan" by Sharma and Tiagi, (1979), "Flora of Rajasthan" by Shetty and Singh, (1987, 1991, 1993), "The Flora of Rajasthan" by Sharma (2002) and the "Flora of Rajasthan especially the South and South-East Region" by Tiagi and Aery, (2007) has further added to our knowledge of the flora and floral composition of Rajasthan. Recently "Flora of South-central Rajasthan" has been worked out by Yadav and Meena (2011), this flora covers Ajmer, Bhilwara, Chittorgarh and Rajsamand districts of Rajasthan. Ethnobotanical studies of different areas of Rajasthan state has been carried out by many workers in this field (Singh and Pandey, 1998; Mishra and Kumar, 2000, 2001; Trivedi, 2002; Katewa *et al*., 2004, Meena and Yadav, 2010). A thorough survey of literature reflects the floral and ethnobotanical studies from other parts of state but no work has been done on floral and ethnobotanical study as well as on family Lamiaceae from Mandal tehsil of Bhilwara district.

MAJOR HYPOTHESIS
(if any)

The floras of the Rajasthan, by Bhandari, (1978), Shetty and Singh (1987, 1991, 1993), Tiagi and Aery, (2007), Yadav and Meena (2011) are available for several regions of Rajasthan, but almost nothing is written for Mandal. The lacuna is however filled during the past five years and a large number of technical and semi-technical papers are published. However a comprehensive flora of Mandal is not available. Therefore the present work is undertaken to bring out a detailed flora of the Mandal tehsil dealing with ecophysiological study of family Lamiaceae as well as ethnobotanical study.

Some of the new species have been recorded from Rajasthan, these studies were related to South Central Rajasthan and the new reported species are *Solanum sisymbriifolium* Lam. (Yadav and Meena 2008), *Senna uniflora* (Mill.) Irwin and Barneby (Meena and Yadav, 2009), *Cleome burmannii* Wight. and Arn. (Yadav and Meena, 2009), and *Microstachys chamaelea* L. (Meena, 2015).

Recently, observations among rare, endemic and threatened plants of Rajasthan are reported by Meena (2014). But other aspects of Ethnobotany are not worked out by any previous workers about this tehsil. Keeping this in mind the present study is undertaken to exploit the Mandal tehsil floristically and ethnobotanically.

These studies will result in valuable references for all plants in one way or the other in general for the students of taxonomy and ethnobotany in particular. Also these will be useful to foresters, medical scientists and those interested in biodiversity, traditional knowledge of indigenous people and conservational aspects of plants. The information will also be useful in the revision of the state or national flora of India.

RESEARCH METHODOLOGY

FLORISTIC SURVEY

The study area will be thoroughly surveyed in all seasons to procure maximum collections and their variants. The field work will consist of collection of plant specimens for herbarium, observation of the habit, habitat, phenology and distribution. The rainy season is perhaps the best time and attempts will be made all these years to visit as many places as possible during this favorable season. The other time suitable for collection is near about October-December when plants are in their full bloom. Besides these, the aquatic plants could be studied as by this time the turbulent water of the rainy season settle down and allow the aquatic vegetation to come up. Flowering stages of some trees also could be collected in this season.

ECOPHYSIOLOGICAL STUDIES

The phytochemichal aspects will be carried out in the laboratory following various methods such as Yem and Willis (1954) for sugars, Bates *et al.* (1973) for proline. Moore and Stein (1948) for amino acids. Farkas and Kirlay (1962) for phenol etc. To find out the stress tolerance of the plants effect of hyperthermia on cell membrane permeability and photosynthetic pigments will be worked out (Sulliyan, 1967). Micro morphological features such as epidermal cell, stomata and trichomes especially of Lamiaceae will be investigated by clearing the leaf with saturated choral hydrate solution. The biological spectrum of the Indian desert is pointed out by several workers viz. Das and Sarup (1951), Pandey and Parmar (1993), but no attention is paid to Mandal tehsil regarding the vegetational studies of Angiosperms.

ETHNOBOTANICAL STUDIES

The undertaken work can be divided into three main stages:

(1) Field work
(2) Literature screening
(3) Miscellaneous methods

FIELD WORK

Before proceeding on field visit the localities will be carefully selected on the basis of the available information of the area to be visited and the people to be studied, taking aid of maps, divisional forest working plans, floras, icons, literature on the tribes and obviously, discussions with relevant personnel. Data on climatic factors, tribal population, geographical conditions, land use pattern etc. will be obtained from district gazetteers, working plans of tehsil and other secondary sources. Information on various uses of plants will be collected through interview with local shepherds, medicine man and other knowledgeable elderly persons belonging to rural or tribal communities and herbal practitioners. Repeated enquiry on various applications of the same plant will be made from different persons of the same village and tribe to ascertain the correctness of information. The voucher specimens will be collected, processed as per herbarium methods identification will be done either in the field or in the laboratory following the different floras (Shetty and Singh 1987-1993); (Yadav and Meena, 2011) and will be deposited in the Herbarium, Department of Botany, M.L.V. Government College, Bhilwara, Rajasthan, India. The linguistic fluency, personality and social standing are crucial in establishment of rapport between the participants involved.

Ethnobotanical data will be collected first hand through:

I. Enquiry
II. Observations
III. Interviews
IV. Participation

LITREATURE SCREENING

Our ancient literature will be tapped for information on medicinal plants. Rig Veda and Atharva-Veda which dates back to 2000 to 1000 BC, which are our oldest Vedic literature resources contain valuable information regarding medicinal plants of that period. Nearly 248 botanical drugs are mentioned mainly in Atharva-Veda and Rig-Veda. A glossary of medicinal plants have been mentioned in Charaka Samhita, Sushruta Samhita and Ashtanga Hridiyam.

Perhaps the outstanding example at least in modern times of the use of the literature is the huge compilation of all anti-tumor plants, cited in old texts and local folk medicine from all over the world for screening purpose at Cancer Chemotherapy National Service Centre (CCNSC).

MISCELLANEOUS METHODS

Updating of nomenclature according to the rules laid down by "International Code of Botanical nomenclature (Vienna Code, 2005)", preparation of keys to genera and species and lastly the treatment of individual families. Names appearing in recent monographs, papers dealing with nomenclature in standard journal and latest floras will be adopted.

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